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Development of a Long-Term, Homogenized Upper Tropospheric Water Vapor Data Set From Satellite Microwave Radiances

2010

Abstract: All climate models predict that the atmosphere will moisten in response to increasing greenhouse gases. The concentrations of water vapor in the upper troposphere are projected to double by the end of the century. This amplified moistening aloft not only represents a key feedback mechanism, but also provides an important fingerprint for the detection and attribution of climate change. Previous funding from the NOAA CCDD program supported our efforts to construct and validate an intercalibrated and drift-corrected data set of satellite infrared radiances from HIRS/2 for the period 1979-2004. This product was the first record to show an increase in upper tropospheric water vapor on decadal time-scales consistent with a positive water vapor feedback and also yielded the first observational evidence of an enhanced clear-sky greenhouse effect due to human activities.
In this proposal we seek to expand our efforts to utilize the growing archive of satellite microwave measurements from SSM/T-2 (1994-present), AMSU-B (1998-present), MHS(2003-present) to construct a long-term homogenized data set of upper tropospheric water vapor. Because microwave measurements are less affected by clouds compared to infrared measurements, the water vapor data set derived from these measurements will have improved space/time coverage and be less prone to clear-sky sampling biases. Most importantly, it will continue the long-term monitoring capabilities of upper tropospheric water vapor which ended for HIRS/2 in 2004.
Specific tasks to be completed under this proposal are:• Develop orbital drift corrections to the microwave radiances from each satellite sensor to remove the effects of orbital drift on the long term radiance trends.• Use simultaneous nadir overpasses (SNO) to intercalibrate the microwave radiances to create individual calibrated records for each satellite system.• Create an upper tropospheric humidity (UTH) product from the intercalibrated microwave radiances to facilitate the analysis of water vapor variations and trends.• Compare to the microwave satellite measurements to climate model simulations from the CMIP5 archive to assess the ability of models to simulate the observed variability and to determine if any of the observed changes can be attributed to human activities.
The proposed work will address the FY 2010 priority of creating a _long-term continuous record,‘ of atmospheric data and the results will be used to evaluate the fidelity of water vapor changes simulated in CMIP5 GCMs.